

GARDNER (Jas. J.)

RELATION

BETWEEN

TOPOGRAPHICAL SURVEYS

AND THE

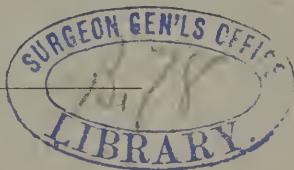
STUDY OF PUBLIC HEALTH.

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By JAMES T. GARDNER,  
DIRECTOR OF THE STATE SURVEY OF NEW YORK, AND SECRETARY  
OF THE AMERICAN GEOGRAPHICAL SOCIETY.

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*AN ADDRESS DELIVERED BEFORE THE AMERICAN PUBLIC HEALTH  
ASSOCIATION, AT BOSTON, OCTOBER 6, 1876.*



ALBANY:  
THE ARGUS COMPANY, PRINTERS.  
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# RELATION BETWEEN TOPOGRAPHICAL SURVEYS AND THE STUDY OF PUBLIC HEALTH.

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By JAMES T. GARDNER,

Director of the State Survey of New York, and Secretary  
of the American Geographical Society.

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An Address delivered before the American Public Health Association,  
at Boston, October 6, 1876.

MR. PRESIDENT, AND GENTLEMEN. — I have left the pressing field duties of our State survey, among beautiful hills in Central New York, and come here to help, if I can, this Association's noble work of rousing and directing American thought in public health studies, by pointing out the importance and necessity of pursuing certain lines of investigation neglected in the past.

The world's old but tireless search for the sources of health has taken a new direction.

Primitive man found, as he thought, the direct origin of all ills in deities whose vacillating human passions must be propitiated by gift and sacrifice.

Then dawning science, recognizing the force of atmosphere as a bearer of heat, cold and moisture, sought to explain the distribution of prevailing diseases by influences of climate, and the popular mind of to-day still clings to many of these doctrines, and under the stroke of pain, bows in blind submission to mysterious powers of the air. But a revolution is taking place in modern thought. The whole tendency of recent investigations proves that *the controlling cause of our most fatal diseases is to be found in local conditions.*

Powerful as are climatic influences in modifying forms of life, science teaches that death dwells not so often in the "viewless winds," which man can neither direct nor restrain, as in the earth beneath his feet, whose form and hygienic characteristics he may mould or change.

Can any one read in the report of the Board of Health of New York that two-thirds of the deaths from diphtheria in that great city were among occupants of first and second floors, and not feel that

the ground about our dwellings is playing a fearful part in swelling the daily list of deaths?

Fourteen years ago Dr. Henry I. Bowditch demonstrated, before the State Medical Society, that certain conditions of the soil slew annually, in Massachusetts, a thousand of her citizens by consumption alone.

I come before you, therefore, as a student of earth's surface-structure, to call attention to the fact that *sources of many prevailing diseases are to be found in various natural conditions of earth's form and substance*, as well as in soils polluted by man. *It cannot be too clearly understood, by every intelligent householder, that the topography and geology of his immediate neighborhood are exercising a controlling influence on the condition of his family; promoting either health and happiness, or sapping the lives of those he loves.* How important, then, that all should know the earth-features favorable to human development! And yet the physician cannot, to-day, direct, with certainty, the anxious inquirer to those localities best suiting physical welfare, nor warn him of unseen dangers surrounding his residence. Laws governing this relation of earth and man are only partially known or guessed at. The time has come when they ought to be determined, and taught in every public school. Our present knowledge of the subject is too general and undemonstrable to be either convincingly taught or practically efficient.

For a hundred years a connection between certain topographical features and malarial fevers has been noticed. Some marshes produce miasma, was the sum of past observations; but malaria appeared accompanying such varied topography that no law of its production was seen until latterly, when character of rock and soil is shown to be as important as conformation of surface in promoting or suppressing malarial fevers, and also rheumatism, cholera, diphtheria, pneumonia, consumption, and many other of man's worst ills. *These diseases appear to be dependent both upon circulation and excess of soil-moisture.* The connection of geological and topographical structure with health will then be evident, when it is remembered that *natural drainage results from combined action of configuration, character of soil, constitution of underlying rock, and the form of its surface.* These four elements regulate natural drainage. Each must present favorable conditions, or deadly waters will accumulate on the surface or in hidden strata. *Remember, too,*

*that no plan for artificial drainage can be completely successful unless based on a thorough comprehension of the natural drainage system of the area under treatment.*

The region above the Palisades on the Hudson furnishes excellent illustration of these statements. The plateau fronts the river eastward with a bluff 300 feet high, and westward slopes gently to the Hackensack valley; its altitude and proximity to the sea both tending to temper the summer climate. All topographical conditions of unusual health seem here present, and yet malarial diseases abound. The reason for this will probably be found in the configuration of the rock. The dense basalt underlying the thin soil of the plateau, absorbs almost no water. Its surface, originally nearly level, was worn by glacial action into low swelling ridges and shallow rock-basins, many of which having no outlet hold stagnant water as great saucers would. The earth conceals them; but their effects are often worse than those of exposed ponds. If the rock were either fissured or porous, the height of the plateau would insure perfect under-drainage; but as it is, we have probably on the Palisades topographical conditions favoring health, while underlying structure is the governing cause of prevailing diseases.

In contrast, consider the formation of the Helderberg plateau, lying also near the Hudson river.

An escarpment 1,000 feet high bounds, on the eastern side, the table-land, composed of horizontal limestone resting on shales.

I recently examined the natural drainage system of this elevated region. From the more level parts water does not pass off by surface streams. Low undulations divide these areas into many separate basins, each draining toward its own center, where a funnel-shaped opening in limestone receives the disappearing flow whose future course is subterranean. These basins are from a few acres to three or four hundred in extent. Where one covers about five square miles a pond is formed at the point of central drainage, finding outlet through fissures of the limestone below. The plateau's elevation insures that these waters sink at once many hundred feet or escape in springs along the cliffs. The Helderberg highland presents, therefore, an admirable illustration of one of the combinations of topographical and geological structure necessary for healthfulness. But this same Helderberg limestone, under different topographical conditions, has proved one of the most powerful producers of disease.

When cholera prevailed in this country, the mortality at Sandusky



was excessive, and some observers hastened to the conclusion that limestone regions were especially liable to the terrible scourge. The press gave publicity to the hypothesis; thousands of people were alarmed, and doubtless the disease was aggravated over limestone regions by excited fears. The truth, as explained by the State Geologist of New York, Professor Jas. Hall, appears to have been this: Sandusky is, indeed, underlaid by Helderberg limestone, through whose many open fissures much foul surface-water of the city easily and certainly found its way downward; but, as the streets have an elevation of only thirty or forty feet above the lake, the drainage sank this small distance and there remained, while its poisonous gasses rose continually through the same open fissures by which the water descended, proving that the very geological conditions which, in combination with other topographical features, appear most favorable to health, here spread beneath Sandusky a deadly network of open drains with no outfall.

If further facts are necessary to illustrate the powerful part that earth's structure is playing in our struggle for life, turn to those reported by Dr. Henry I. Bowditch, in his admirable paper on "Consumption in New England, or Locality one of its Chief Causes." His map of the distribution of consumption in Massachusetts shows towns where the disease is most rife, side by side with those where it is rarest. Even in one-half of some towns consumption will prevail, while the other is almost free. Here, doubtless, the lungs are most affected by local causes. What, then are these local causes? Dr. Bowditch thinks that the most powerful agent is "soil moisture," resulting from certain combinations of geological and topographical structure. The facts stated are many and significant, but perhaps none are more marked than those from the town of Greenland, N. H. This town has three distinct divisions of soil: 1st. A higher and dryer sandy plain. 2d. A medium, fertile, rather moist portion. 3d. Extensive low marshes. Seven hundred and fifteen residents are about equally divided between the three districts. During ten years three people died of consumption on the sandy plain, five in the medium, and ten in the wet region. Here, out of the same number of people, three times as many died in the lowland as on the higher ground. But in the town of Saccarappa, Me., where the hills are of a clayey loam, and the valleys gravelly, thirty-one per centum of the deaths on the hills were from consumption, and only sixteen per centum in the plain district.



One cannot read such facts, placed in their proper relation in Dr. Bowditch's paper, without being convinced that there is an intimate connection between earth's surface structure and the disease which causes from sixteen to thirty per centum of all deaths in New England. At the same time, however, the reader is forced to acknowledge that Dr. Bowditch had not at command those facts necessary to prove exactly what structural features produce consumption. Why he did not have the facts, and why no physician can now have them, will be evident from the illustrations that I have given of the probable cause of disease on the Palisades and at Sandusky. The source of the trouble in these regions is doubtless a geological feature which none but a special student of structure could discover. In this grave matter I am forced to speak of probabilities, when we ought to have the certainties of physical law; because the statements laid before you prove not only a vitally important hygienic connection between man and geological and topographical structure, but they show also how vague and uncertain our information is concerning the laws governing this relation. *These laws can never be demonstratively known until a detailed topographical and geological survey is made of some large area, and followed by a thorough sanitary survey of the same region.* I am before this association to-day principally to impress this point, *that the geographer and physician must work together in study of the public health; and that to discover causes and determine laws they must pursue the only method known to science—first collect and classify facts, then compare them.*

The geological and topographical structure, controlling, as it does, both natural and artificial drainage, must be determined by observers trained in these special branches of science. Their labors must result in maps and diagrams, picturing to the eye earth's surface, configuration and hidden anatomy, and in records of the chemical constituents of rocks, soils and waters. Every hill, every stream, each plain, each pond, each swamp, must appear upon the map, and all buildings, roads and important artificial works, in their true relations to the natural features. Then let the philosophical physician place beside these structural maps and records his carefully collected statistics of diseases of this region, arranged according to geographical distribution, and the general laws governing the relation of earth's features to health will unquestionably appear. The conditions that doubtless modify and mask these laws in many localities, will also be detected by referring to recorded observations of the

sanitary surveyors in each district. Gravelly slopes might, in general, prove extremely healthful, while in special cases those residing upon them would, perhaps, be excessively liable to disease. Here the records of the sanitary surveyor would, perhaps, show cesspools, so placed that their poisonous waters would permeate the soil and pollute the wells. Without a record of the existence and position of these sinks, the law of the hygienic action of structure would appear to be reversed, when in reality the results exactly accord with the general law. The very geological and topographical conditions which normally are most healthful, easily change under human treatment into sources of sorrow and death.

Careful records by sanitary observers must thus supplement the work of topographers and geologists, before the necessary data can be supplied to make an investigation, which shall render laws of healthfulness in residence sites so evident that every school boy may know them.

*From the united results of topographical, geological and sanitary surveys of a large area, I believe it possible to deduce, with absolute certainty, the principal causes of prevailing diseases, and to point out practical remedies that will reduce the death rate to one-half its present amount, and banish from the world an untold weight of suffering and sorrow.*

Can any triumph of applied science be greater than this? Will there be found, hereafter, any excuse for us as an association if we neglect, first, to determine what are the only methods by which reliable facts can be collected to solve this great problem — the cause of prevailing diseases, and then to urge upon the country those measures necessary to secure the making of such a collection at the earliest moment.

The admirable report of our honored Secretary, Dr. Elisha Harris, Mr. Fred. Law Olmstead, Mr. Wm. Richardson and Mr. Trowbridge, assisted by the geologist Prof. Newberry, on the causes of prevailing diseases on Staten Island, and the improvements necessary to secure healthfulness, is a model of what can be done in a private way toward solving the general problem; and it is to these and similar efforts that we owe our knowledge of the general lines upon which to pursue final investigations. But these gentlemen who have labored so devotedly to gather data, which, though defective, still indicate laws, are the ones who most clearly understand that *the great body of structural and sanitary facts necessary*

*as a basis for the science of public health must be collected by trained corps of observers acting under State governments. Private effort has, I believe, already demonstrated that State topographical, geological and sanitary surveys must be made, before the most important laws of health can be determined.*

If this be so, then the American Public Health Association ought to publish the fact, and the proof of it, throughout this broad land, teaching all legislators that the health and happiness of every family depend on the prosecution of State surveys.

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#### LETTER FROM THE SECRETARY OF THE ASSOCIATION.

THE AMERICAN PUBLIC HEALTH ASSOCIATION, }  
 NEW YORK, *October 24, 1876.* }

JAMES T. GARDNER, Esq., C. E.,

*Director of the State Survey :*

DEAR SIR. — The Publishing Committee directs that the following copy of resolutions adopted by this association at its annual meeting be forwarded to you, with an expression of cordial approval of the immediate printing of your address. No topic which we have discussed or studied in its relation to public health interests has awakened so deeply the scientific and practical men of this association as has this timely presentation of the sanitary relations of topographical surveys and maps. The plan and ultimate results of the great work in which you are engaged, under the Board of Commissioners of the State Survey, are well designed to promote the public health interests of the State, and to supply the very cornerstone of exact and universally essential sanitary knowledge and practice.

Respectfully yours,

ELISHA HARRIS, M. D.,  
*Secretary of the Association.*

[COPY FROM MINUTES.]

BOSTON, *October 6, 1876.*

*Whereas*, This association has projected and wishes to encourage a systematic and complete sanitary survey of the United States, and fully appreciates its importance.

*Resolved*, That it is the opinion of the American Public Health Association that in every State, especially in the populous ones, a thoroughly accurate topographical survey is so essentially necessary as a basis of sanitary surveys and systematic drainage, and also the most desirable hygienic researches and works for prevention of disease, that the execution of such State surveys is a public work which should be undertaken by the State as a duty to the life and welfare of the people.

*Resolved*, That the statement of the sanitary aspects of topographical surveys and maps, as presented in Director James T. Gardner's address this morning, accords with the best established facts in sanitary science, and that the prosecution of State surveys which will promote sanitary knowledge and human welfare in the manner set forth in this address is a duty which should be encouraged by the people and legislators of the several States.

Unanimously adopted.



